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Introduction to Novel Drug Delivery System.

A.R.GOLHAR[*1], V.K.GHUME[1], A.N.MEREKAR[1], M.D.DOKHE[2]

1. *Department of Pharmaceutics, Dr. Vitthalrao Vikhe Patil Foundation's College of Pharmacy, Viladghat, Ahmednagar-414111*
2. *Department of Quality Assurance Techniques, Dr. Vitthalrao Vikhe Patil Foundation's College of Pharmacy, Viladghat, Ahmednagar-414111*

Corresponding Author: *Miss. Golhar Aarti Rajendra*
Department of Pharmaceutics, Dr. Vitthalrao Vikhe Patil Foundation's College of Pharmacy, Viladghat, Ahmednagar-414111

Abstract: *In the present scenario, India is progressing remarkably in DDS focusing mainly on at R and D activities and consequently various newer and controlled DDS like transdermal, ocular, aquasomes, ethosomes, liposome's related erythrocytes, implants etc. have been developed. These have a large number of advantages over conventional dosage forms like controlled and predictable release, lesser chances of dose dumping, reduction in the frequency of administration, minimization of side effects etc. given below are some newer drug delivery system described in short which are explained in the given article.*

Key words: *Drug delivery, Microencapsulation, Implants.*

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I. Introduction: [1]

A drug delivery system (DDS) is defined as a formulation or a device that enables the introduction of therapeutic substance in the body and which improves its efficacy and safety by controlling the rate, time and place of release of drugs in the body. This process includes the administration of the therapeutic product, the release of the active ingredient by the product, and the subsequent transport of the active ingredients across the biological membranes to the site of action. The term therapeutic substance also applies to an agent such as gene therapy that will induce in vivo production of the active therapeutic agent. Gene therapy can fit in the basic and broad definition of a drug delivery system. Gene vectors may need to be introduced into the human body by novel delivery methods. However, gene therapy has its own special regulatory control. Drug delivery system is an interface between the patient and the drug. It may be formulation of a drug, to administer it for a therapeutic purpose or a device used to deliver the drug. This distinction between the drug and the device is important, as it is the criterion for regulatory control of the delivery system by the other than drug administration, such as therapeutic effect by a physical modality or a drug it6 is regulated strictly as a device. There is a wide spectrum between drugs and device. There is wide spectrum between drugs and devices, and the allocation to one or the other category is decided on a case by case basis.

Sustained and controlled release drug delivery: [2, 3]

The rate at which a drug is released from resonate is dependent on many factors. In many cases, the rate is sufficiently slow so that the resulting effect is a controlled or sustained release over many hours. Further medication can be achieved by the use of coatings that restrict the release, or control the site of release. Examples, of drugs where this technique is currently used include dextromethorphan (coated), diclofenac and nicotine. Another advantage that this technology brings is that the drug itself does not have to be in crystalline form. The resistance will be a solid, with similar characteristics to the original ion exchange resin powder and, as such, can be formulated into any of the traditional solid dosage forms.

Microencapsulation: [4]

Microencapsulation is defined as process where small droplets or particles of solid or liquid substances are coated by a continuous film of polymeric materials. The maximum therapeutic efficacy can be achieved by delivering the active agent in the optimal rate to the target tissue and causing little toxicity and minimum side effects. Delivery of a drug in a sustained controlled release manner is done by using microsphere as carriers for drugs. In the microencapsulation, the coating of the particles is ranging dimensionally from the several tenths of a micron to 5000 micron size.

Parenteral controlled release system: [5, 6]

The parenteral route of administration is the most common and efficient method for delivery of drugs with low bio-availability and with a narrow therapeutic index. For this reason, in all drug delivery systems efforts to reduce the frequency of injection throughout the drug therapy will not only beneficial in terms of compliance, but also improve the quality of the therapy. Such a reduction in the total number of drug dosing is achieved by the use of such a formulation technology that assures that the release of the drug is in a controlled manner. Depending on the dose of several drugs, it may be possible to minimize the injection frequency from daily to once or twice monthly or even less frequently. In addition to this, humanizing patient comfort and reduced the frequency of injection of drugs in the form of depot formulation are the objective of parenteral controlled release system. Such depot formulation has the potential to not only boost the therapeutic benefit but also to reduce unwanted side effect.

Buccal drug delivery system: [7]

Buccal region deals with an acceptable route of administration for systemic drug delivery form the various transmucosal available sites, Buccal cavity mucosa is the most convenient also easily approachable site for the purpose of delivery of the therapeutic agents for both Buccal as well as systemic delivery used as retentive dosage forms. Mucosa has a rich blood supply so it is relatively permeable. The Buccal drug delivery system involves fast dissolving tablets, sublingual tablets, chewing gum, buccal patches.

Transdermal drug delivery systems: [8]

Transdermal drug delivery system is defines as, distinct dosage forms which, when applied the intact skin, deliver the drug through the skin at a controlled rate to the systemic circulation. Topical application has also been used for centuries, predominantly in the treatment of localized skin disease. Local treatment requires only that the drug permeates the outer layer of the skin to treat the diseased state, with the hope that this occurs with little or no systemic accumulation.

Ocular drug delivery system: [9-16]

The complexity of the eye provides unique challenges to drug delivery strategies. Conventional eye drops, used for treating many ocular disease suffers from various disadvantages. Elderly patients, children and even experienced users injure their eyes leadings to bacterial contamination upon contacting with the bottle tip. Preservatives also known to cause morphological changes to important parts of the eye such as conjunctiva, cornea and tendon leading to change in scarring behavior after glaucoma surgery. For maintaining chemical stability of the drug dissolved (for example, homatropine, pilocarpine etc. preservatives and pH adjustments have to be added. Both of them causes enhanced tear flow resulting in poor pharmacokinetics of eye drops due to dilution of the active moiety. Preservative induce irritation such as tearing, stinging, hyperemia, burning and allergy and punctuate dermatitis, a common ocular side effect of usual eye drops. In general drug delivery devices like the NODS (new ophthalmic drug delivery system) and accuser have been demonstrated to be harmless and tolerated in the human eye and are efficient delivery systems.

Nasal drug delivery systems [17-21]

Nasal administration offers an interesting and promising alternative technique for achieving the systemic drug effect to the parenteral route. Now days, many drugs have better systemic availability through the nasal route as compared to oral administration. Biotechnological advancement has leaded to the development of new and large number of protein and peptide frogs for the treatment several diseases. Oral administration of the drug is not possible because they are significantly degraded in the GIT or considered metabolized by first pass effect in the liver. Intranasal drug delivery offers a promising alternative route for administration route for administration of such drugs. Nasal drug delivery systems are also suitable when restricting and obstacle blood brain barrier has to be crossed so that drug can be subsequently delivered in the biphasic of CNS. It is also considered for the administration of vaccines. Nasal route has also been considered for the administration of vaccines. The interest in nasal route for therapeutic purposes arises from the anatomical, physiological and histological characteristics of the nasal cavity, which provides rapid systemic drug absorption and quick onset of action.

Pulmonary drug delivery systems: [21, 22]

Pulmonary route has been used to treat various respiratory diseases for centuries. Ancient inhalation therapies include the use of leaves from plants, vapors from aromatic plants, balsams and myrrh. The development of an inhalation therapy that is safer depends on the pharmacological activity of molecule and on the delivery system and its applications. The respiratory tract is exposed to a relatively very large number of biological and non- biological particulates. It is characteristics of the effectiveness of lung defense mechanism

that healthy people's lungs are sterile below the larynx. In the treatment of obstructive respiratory disease, pulmonary delivery can minimize the required dose since the pulmonary route is the best alternative to other routes injection is an unpleasant prospect with a host of hygiene issues and potential side effects. At its worst, it can create a barrier to patient compliance with the particular drug regimen required to most effectively treat a given disease, since some patients choose irregular treatment or no treatment at all when faced with frequent injections.

Intra uterine drug delivery systems: [23]

An intra uterine device (IUD) is a small plastic contraceptives device that is gently inserted into the uterus (womb) by either a physician or nurse practitioner. IUD are about 98-99% effective in preventing pregnancy and one type of IUD can stay in place for up to 10 years before needing to be replaced. Once inserted, the IUD is immediately effective and when removed, its contraceptive effect is immediately stopped. The IUD may affect the way the sperm or egg moves and it is thought to prevent the egg and sperm from uniting (fertilization). The copper IUD also causes thickening of the cervical mucus, providing a barrier that prevents sperm from entering the uterus. IUD is very safe and effective for most women. The IUD is an excellent choice woman who has children and now wants long term, nut not permanent contraception. The IUD may also be a good choice for women who cannot take birth control pills, use DEPO- Provera or Norplant and for those who choose not to use a barrier method of contraception such as diaphragm or vaginal foam.

Gastro intestinal drug delivery system: [24]

A major limit in oral controlled release drug delivery system is that not all drugs are absorbed consistently throughout the GIT. But some drugs are absorbed regularly throughout gastrointestinal tract. Some drugs are absorbed in exact proportion of gastrointestinal tract only or are absorbed to a different extent in various segments of gastrointestinal tract. Such drugs are said to have an "absorption window". Thus, only the drug released in the region proceeding and in close surrounding area to the absorption window is available for absorption. After crossing the absorption window, the released drug goes to waste with negligible or no absorption. This phenomenon severely decreases the time available for drug absorption and limits the success of delivery system. These considerations have led to the progress of oral gastro retentive dosage forms (GRDF) possessing gastric retention capability. One of the most feasible approaches for achieving a prolonged and predictable drug delivery profile in gastrointestinal tract is to control the gastric residence time (GRT) using GRDF that offer a new and better option for drug therapy. Dosage forms that can retain in stomach are called gastro retentive drug delivery systems.

Targeted drug delivery system: [25-28]

The drug targeting is used for delivery of drugs to organ of part or body or the receptors of body to deliver the drug exclusively. Using this definition, two distinct approaches are as follows: 1) the drug is directed selectively to the target site where it is concentrated and show its response. 2) The chemical agent is systematically available but is active and/or activated at only the target site. Targeted drug delivery research is done on area which concentrates on the development and evaluation of systems with precise characteristics. The characteristics can be selective or regional drug delivery, controlled drug delivery, or the combination of these characteristics. Targeted delivery system can be made available for routine use. It is important that the evaluation procedures are critically established and the advantage over a conventional dosage form, if any, clearly documented. The development of preclinical evaluation of microsphere, drug- conjugates, liposomes and similar systems.

Brain targeting drug delivery system: [29-30]

Brain targeting is a targeting of drug to a specific site of the brain for the desired duration to obtain pharmacological action. The brain is a delicate and composite organ in the human body and evolution has built extremely competent ways to protect it. It would not make sense for it to become the battle field of infection and immune response. Tremendous advances in brain targeting research in the world's leading cause of disability, brain and central nervous system disorders account for new hospitalizations and extended care than most all other diseases combined.

Nano carriers drug delivery system: [31]

Pharmaceutics, in about 90% of all medicines, the active ingredients are in the form of the particles. With the development in nanotechnology, it is now possible to prepare drug nano particles by a variety of innovative ways. Nano technology is frequently applied in fiber, textiles, agriculture, electronics, forensic science, space and medical therapeutics namely disease detection, controlled drug delivery, as biosensors in tissue engineering and so on. This nano particles drug formulation reduces the patient expenses and risks of

toxicity. Nan capsulation of medicinal drugs (nanomedicines) increases drug efficacy, specificity, and therapeutic index of corresponding drugs. New drug delivery pathways can be used that can increase drug efficacy and reduce side effect. For better development of the nanoparticulate systems, it is essential to understand the pharmaceutically relevant properties of nanoparticles.

Proteins and peptides: A new emerging approach for drug delivery: [32]

The parenteral is the most common route of protein and peptide drug delivery. However this route is associated with pain on administration resulting in poor patient compliance and the formulation needs to be sterile. Drugs administered by the gastro intestinal route are expected to acid hydrolysis and extensive gut and/or hepatic first pass metabolism. Thus, these protein drugs may exhibit poor oral bioavailability. Non-invasive mucosal and transdermal delivery route is limited to potent drugs while lipophilic compounds does not provide rapid blood levels and is less permeable than oral mucosa. Various absorption mucosas have been identified and investigated for systemic drug delivery. These include nasal, ocular, pulmonary, rectal, vaginal mucosa.

Implantable drug delivery system: [33]

Implantable drug delivery systems are present totally under the skin in a suitable but not noticeable location. The patient does not know of tiny colloid particle under the skin. Implantable drug delivery systems are intended to pass the drugs and fluids into the blood stream without the constant insertion of needles. Two approaches to this problem appear possible and feasible. The most important approach is the use of implant electrically driven pumps which can be refilled by simple injection of the drug through septum into the pump reservoir. The one main disadvantage is the large size of the device and the need for surgical implantation with the possibility of infection. The use of polymeric systems in future as implants requires greater input from polymer chemistry and allied fields.

Other delivery systems: [34]

Other delivery systems (ODS) deal with such systems which are the part of NDDS and play an important role in the delivery of the drugs. ODS involves implants, prod rug, etc.

Dissolution: [35, 36]

Dissolution is defined as the process in which solid molecules enter in the solvent to produce the solution. Generally, we stated that the solid substances are completely solublizer in a given solvent. Many methods have been described for the determination of rate of drug release into solution from the tablets, capsules and other dosage forms. Various USP apparatus are used in dissolution of different dosage forms such as basket types, paddle type, reciprocating cylinder, flow through cell, and paddle over disc, rotating cylinder, reciprocating holder.

Microemulsions: [37, 38]

Microemulsions are thermodynamically stable, optically transparent, isotropic dispersions of aqueous and hydrocarbon liquids stabilized by an interfacial film of surfactant molecules. Micro emulsion is mono dispersed spherical droplets (diameter 20-200 nm) of w/o or o/w, depending on the nature of the surfactant. A macroscopic scale, a micro emulsion looks like a homogenous solution but at a molecular scale, it appears to be heterogeneous. Micro emulsion as a drug delivery tool shows favorable properties like thermodynamics stability (long shelf life), easy formation (zero interfacial tension and almost spontaneous formation), and optical isotropy, ability to be sterilized by filtration, high surface area and very small droplet size. The small droplets also provide better adherence to membranes and transport drug molecule in a controlled fashion. Micro emulsion is easy to administer to children and to people who have difficulty in swallowing solid oral dosage forms.

Multiple emulsions: [39, 40]

Emulsions are thermodynamically unstable systems that tend to break down over time due to a variety of physicochemical mechanism, including gravitational seperation, flocculation, coalescence and Ostwald ripening. Multiple emulsions are more complex system as the drops of dispersed phase themselves contain even smaller dispersed droplets which normally consist of a liquid that is miscible and in most cases is identical with continuous phase. It is an emulsion in an emulsion so it is called as multiple emulsions or it is also known as a double emulsion or complex emulsion. The substances that makes up the droplets in an emulsion is referred to as the dispersed phase, whereas the substances that makes up the surrounding liquid is called as the continuous phase. W/o/w emulsion consists of water droplets dispersed within larger oil droplets, which are they dispersed in an aqueous continuous phase.

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